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CAUSES OF FOREST ROTATION.

BY JNO. T. CAMPBELL.

(Continued from p. 527, June number.)

SINCE my article on the above subject appeared in the June NATURALIST, I have received a good number of letters, both from acquaintances and strangers, some making further inquiry about some phases of the subject, some offering explanations different from mine to account for forest rotation, and still others ridiculing my theory that seeds, especially nuts, are carried by crows, wood-peckers and squirrels sufficient to plant such large districts of young forest trees as suddenly spring up where forests of a different timber have been cut away, or such as have sprung up on the prairies of the Wabash river second bottoms since the white settlers have stopped the burning of the prairie grass.

I have been struck with the number of persons who seem to believe (as indicated by this correspondence) that when a forest is swept away by the axe, fire or a blight, a different kind of forest springs up spontaneously out of the soil. I admit that it has much that appearance. Especially does it appear to be so with weeds and grass, but the seeds of the latter are so small that it is about impossible to keep track of them; but forest trees that grow from nuts we may more easily observe, and if we find that their seeds have been carried far beyond their fall from the parent trees, and planted so as to produce trees, we may, I think, take the planting of weed and grass seeds for granted.

Dr. Clevenger, of Chicago, in a letter says, in speaking of the oak following pine in Minnesota, where the latter was cut off of the railroad sections: "My idea was, that during hundreds of years the chemical constituents of the soil having been drawn upon for the sustenance of pine, something near exhaustion had occurred, or at least enfeeblement of the ground, and that a seed which in its development required different soil constituents, or complementary ones, would be most apt to succeed the pine. The oak seems to be universally the terebinthinate follower in Scandinavia, Scotland, England, America and elsewhere. * . * * For hundreds of miles along the Minnesota division of the North Pacific railroad, the alternate sections of cleared and uncleared forest presented, the year after clearing, a checker-board aspect of young oak and old pine. Then why should beeches and larches

everywhere follow the oak destruction? It seems to me the true explanation comes in climatological changes as minor, and soil-chemistry changes as major causes."

I admit the puzzle the doctor produces. Perhaps neither of us is right in accounting for forest rotation. My theory—which I have offered only as a suggestion or query—that perhaps most forest seeds will not grow in the leaf-fall of the parent tree, and that nuts are transported long distances and in great numbers by crows, woodpeckers, squirrels, &c., while it is possible, and seems to me probable, may not be the *fact* that accounts for oak following pine in Minnesota in the manner stated. But I must be allowed to believe a few days longer that an oak starts from an acorn.

It is remarkable how often we all (and many very intelligent and scientific persons are included) ponder, wonder and speculate about a phenomenon, the evidence to solve which lies at our feet. If the doctor, while on the ground, had examined a few of the infant oaks, I think he would have found an acorn attached. And if he had, the only unsolved question remaining would be—How did the acorn get there? As it is, the first question to settle is whether the oak came from an acorn or spontaneously from the ground. In my locality the acorn and the dark mold-cast which it leaves in the ground can be identified as late as the third year after sprouting.

Professor George K. Greene, of New Albany, Indiana, writes: "If you were to visit the section of country in Harrison county, Indiana, called the "barrens," you would find an area of several thousands of acres all grown up with post oaks (*Quercus obtusiloba*). There are citizens residing in the vicinity who came there when there was no timber on the ground. Can your crows and squirrels account for this?"

I will answer this by describing the work of the crows in this vicinity about the year 1847. John Williams loaded a flat-boat with chickens for the New Orleans market. Such a boat could, and his probably did, carry three thousand chickens. Of these two thousand would be hens, as the farmers generally kill the males for their own table use. This boat in running over Manwarring's mill-dam sprung a leak and sunk so fast that all the chickens had to be turned loose in the woods on the north side of the creek, and about a half mile above where it enters the

Wabash river. There the hens laid about two thousand eggs a day for about a week, while the boat was being repaired, making about fourteen thousand eggs laid. The crows carried these eggs—how many I can't say—southward across the creek and buried them in Huxford's field, more than a half mile distant. That was in early spring. Soon after Huxford and his boys broke that field for corn, and the plow turned up hundreds of eggs, and perhaps thousands, as they were too numerous to think of counting. When the broken ground was afterward furrowed off for planting, many more eggs were exposed, and after the corn came up and was being plowed, hundreds more were exposed. Very probably the plows exposed less than two-thirds of those buried, as the plow-cut would go below the depth likely to be buried. Huxfords took their dinners to this field, and they cooked the eggs thus found by the fire where they made their coffee, and the eggs remained good till the first plowing of the corn in early May, when they became tired of them and ceased to notice them further. John Huxford, a wealthy farmer of this county, and one of the boys who plowed the field, told me about finding and using the eggs.¹ The "stoving" of Williams' chicken boat I myself remember, as I then lived with an uncle on Sugar creek, not more than three miles distant from the field.

Might this not be a good way to preserve eggs? The field was dry, alluvial, rather sandy soil.

Suppose the eggs had been acorns, and the field had not been disturbed with the plow, and also suppose the rank bottom-weeds

¹ Since writing the above, I have seen and talked again with Mr. Huxford, and find that I am mistaken about an immaterial fact. It was not the boat that was injured on the mill-dam, but one that was built there several years later. The farmers brought their chickens in before the boat was ready, and turned them loose in Cheezem's orchard on the south side of Sugar creek. The crows carried the eggs across to the north side of the creek, and buried them in the Chatsey field (which was sold for taxes, and Huxford bought it). The balance of the statement is correct. I presume I inferred the stove boat, because it occurred at the same place.

I have told this circumstances often, and have found people who manifested some skepticism, because of its rare occurrence. But I have also found several other persons who have found eggs buried in the ground, and they also say the eggs appeared to be sound when found. Hens, when not too much confined, hide their nests, and the cautious crow does not venture into ambush to find them. It was *then* rare that chickens were crowded together but uncooped, in such numbers, and since shipments are made by railroad it never occurs; so of course the case is a rare one. Any one acquainted with the habits, or nature of the crow, knows he is much given to carrying things from place to place and burying them.

had exercised polite forbearance and kept out of the way ; would there not have been founded a dense oak forest ?

In the fall of 1876 and winter and spring of 1877, I was surveying a line of railroad in Southern Illinois. About five miles west of Benton, the county seat of Franklin county, the line of survey cut across peninsulas of prairie extending into the timber, and likewise peninsulas of timber extending into the prairie. These are called arms of prairie and points of timber. The old timber followed up the small streams into the prairie. The buffalo and deer, in past time, kept the grass eaten and tramped down along the water-courses where they drank, thus greatly reducing if not entirely preventing the destructive prairie fires from consuming the young trees ; hence the points of timber following up the streams. In the locality I am describing the timber was almost exclusively white oak. After the settlers stopped the prairie fires, these points of timber began to widen and crowd on the prairie, and in the last forty to fifty years the young oaks had extended out about a half mile from the old timber, and they ranged in height from about fifty feet next to the old trees, to the infants just emerging from the ground out at the frontier. At that frontier I saw oaks, not over four feet high, bearing acorns—keeping the seed right up to the front. In Indiana, where it is unnecessary for trees to perform the parent functions so young, I never saw a white oak less than thirty feet high bear acorns, and not then among older oaks.

In the second or terrace-bottoms of the Wabash river, when the whites first settled them, they found most of them to be prairie, grown up in weeds, the prairie grass had not yet got possession of the ground except in patches. They found also scattering and stunted white oaks, black oaks (*Quercus nigra*) and jack oaks (*Quercus ferruginea*). The Indians had, for an unknown time, burned the prairie weeds and grass, which not only killed the infant trees but greatly injured the old ones, especially on the south side, where to-day, notwithstanding seventy years of protection from fires, they still show the scars, though generally healed over, and on their sawed-off stumps can be read the true history of their lives. After the prairie fires were effectually stopped, a dense growth of young trees sprang up, and to-day they are fifty to seventy-feet high, vigorous and thrifty. Last year I had occasion to hunt for piling timber in a grove of this

timber on the Walker farm, about twelve miles north of Terre Haute. Some one had sawed down many of the trees, for some purpose, and while waiting for a team I counted the age of the trees by the concentric annual rings on the stumps. Notwithstanding that their diameters varied from six to twenty-two inches, every one of forty I counted was sixty-four years old. Their ages tallied with the date when the fires were suppressed. The prevailing young trees in that grove were jack oak, though there were a few white oaks, hickories, poplars and black walnuts among them, and these were as tall and thrifty as the prevailing kind. The prevailing old scattered, stunted trees of that locality were white oak, but the young white oaks showed no lack of thrift and vigor in growing by the stumps of their parents.

In Ohio, on the east side of the Big Miami river and about a half mile south of the line between Hamilton and Butler counties, Old Major Cilley (a relative of the Cilley who fought a duel with Graves, in Jackson's time) undertook to clear ten acres of land on the Miami hills. This was about seventy to ninety years ago, I am not sure as to exact date. He felled the trees when in full leaf, and after they were well dried, fired them and burned everything clear. The next spring the black locusts sprouted as thick as weeds in a field, wherever the fire had been. For some reason the ground was not plowed, and the trees soon grew to be valuable timber, as it makes the best of fence and gate-posts. There were a few parent black locust trees in the vicinity, but they were by no means the prevailing forest tree there. Their seeds resemble an apple seed, are very hard, and must undergo a process of scalding, scorching or very hard freezing and then have a clear field before they will grow. Their seeds being small are easily carried by the wind, and are so impervious to ordinary weather influences that they may lie among the forest leaves many years, and when some subsequent favorable condition transpires, as the burning of Cilley's fallen timber, they sprout into life and make a locust forest.

In further consideration of Dr. Clevenger's idea of soil exhaustion as the cause of a change in the kind of timber, I will say that in all the pine forests I ever saw, the individual pine trees showed no more evidence of enfeeblement, as I should expect in case of soil exhaustion, than do the trees of the forests here, where all kinds grow promiscuously together. A few years would

test this question, if somebody would plant an infant pine and oak together near a grown oak, and the same near a grown pine. There should be several of each plant to guard against accidents to either kind spoiling the comparison, and then observe their comparative progress a few years. Has anybody ever done this? Will somebody who has an opportunity please do so?

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BUFFALO AND CHICAGO, OR "WHAT MIGHT HAVE BEEN."¹

BY PROFESSOR E. W. CLAYPOLE.

THE great spectacle which Buffalo can show to the members of the association needs no description. Met as we are, almost within sound of the cataract, we are tempted to ask concerning it many questions, to answer which would not be easy. But to us who compose the Section of Geology, Niagara is a study of peculiar interest. The structure and age of its rocks, the formation of the great gorge and the various causes that have combined to produce it, all these topics have received careful consideration, and though our queries are far from being fully answered, yet the partial replies already extorted from nature are deeply interesting and strongly suggestive.

Most of these points are, however, familiar to geologists, and I do not therefore propose to dwell upon them. They have already claimed and will again claim our attention. But there is one, both curious and interesting, to which I wish to refer for a few minutes.

In the study of history it is often both entertaining and instructive to stop in one's regular course, and dropping the thread of the narrative of actual facts, to consider what might have been the course of events had certain great and critical occurrences not happened at all, or happened in a different manner or under different conditions. These "might have beens" of history, though of course impossible, are not necessarily useless to the student. A consideration of some of them sometimes shows us on how slender a thread have depended most momentous results. The delay of a few hours, the failure of an apparently unimportant coincidence would in many cases, so far as we can see, have

¹ A paper read in abstract before the Geological section of the A. A. A. S. at Buffalo, August, 1886.